

# Advances in the Diagnosis and Treatment of Rotator Cuff Tears

Nicholas J. Avallone, M.D.

Orthopedic Surgery

Sports Medicine Specialist

# Conflicts

- I have no conflicts related to this talk



# Goals of Talk

- Understand anatomy and function of cuff
- Understand etiology of Cuff Tears
- Learn key history and physical exam findings of rotator cuff pathology
- Identify a Rotator Cuff Tear on MRI
- Understand Non-operative options
- Identify appropriate surgical candidates
- Understand arthroscopic cuff repair techniques
- Identify patients appropriate for new Reverse Total Shoulder Prosthesis

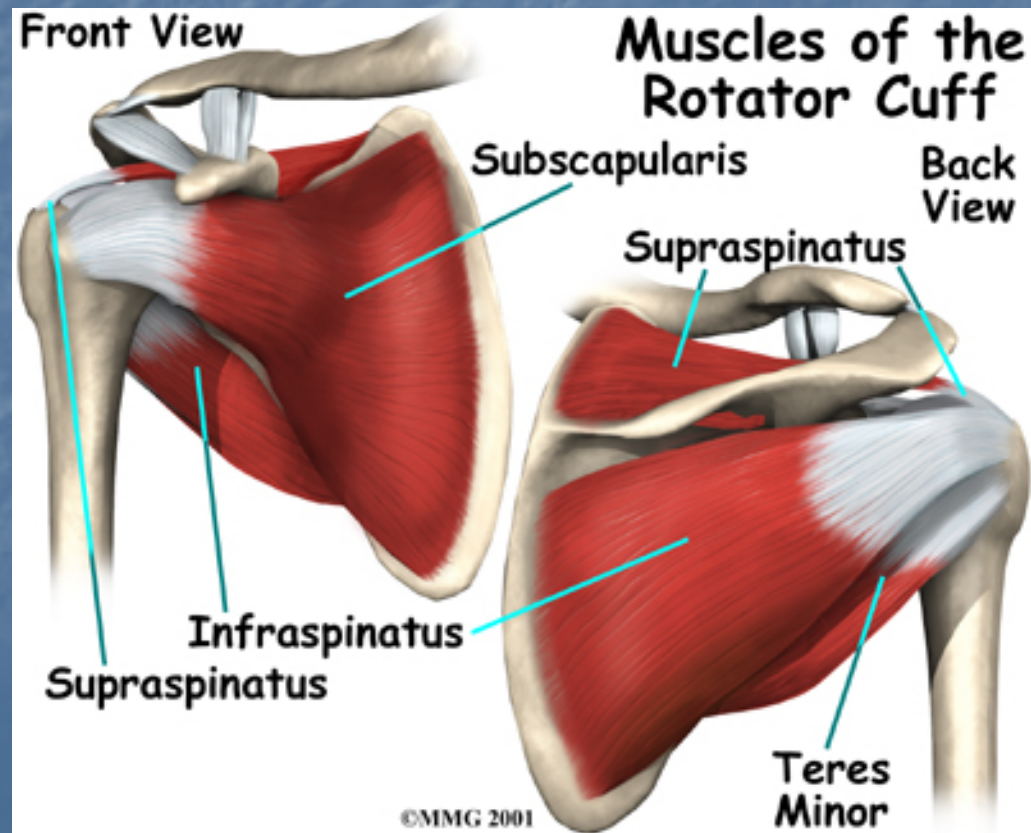


# Anatomy



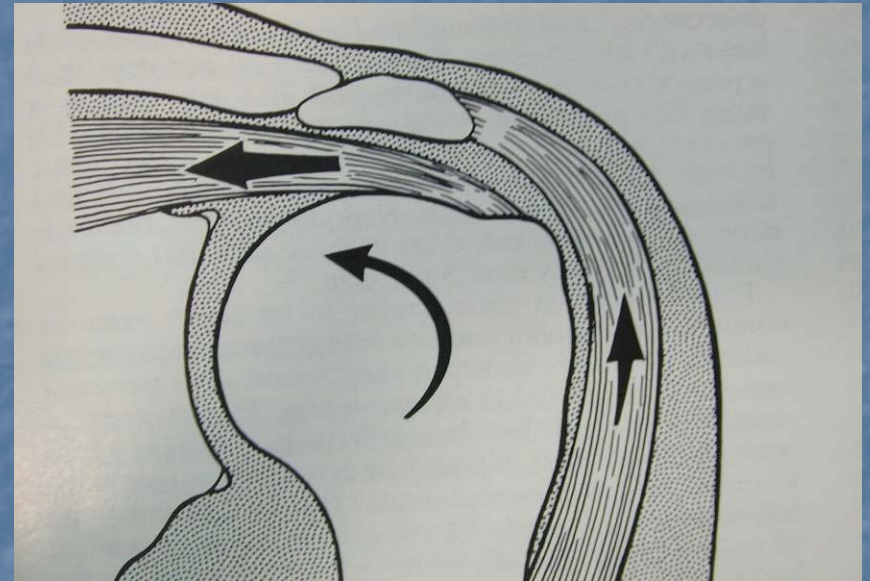
# Anatomy

- Enveloping cuff of tendons help move the shoulder in space
- Subscapularis
- **Supraspinatus**
- Infraspinatus
- Teres minor



# Function

- Provides dynamic stability to shoulder
- Act as key part of force coupling in shoulder motion-
  - keeps the golf ball on the tee
- Contributes to power as well
  - supraspinatus and infraspinatus provide 45% and 90% of abduction and external rotation strength respectively





# Etiology of Cuff Tears

# Many Different Causes

- Trauma
- Vascular
- Impingement
- Degenerative
- Scapulothoracic/scapulohumeral muscular imbalance
- Developmental
- Instability
- Inflammatory disease
- Iatrogenic
- Multifactorial





# Pathogenesis of Rotator Cuff Tears

- Vascular factors
  - intrinsic
- Impingement
  - extrinsic





# Vascular Factors

- “watershed” area or “critical zone” 1 cm proximal to insertion site is the most common site of cuff tears (Mosely and Goldie, *JBJS Br*, 1963)

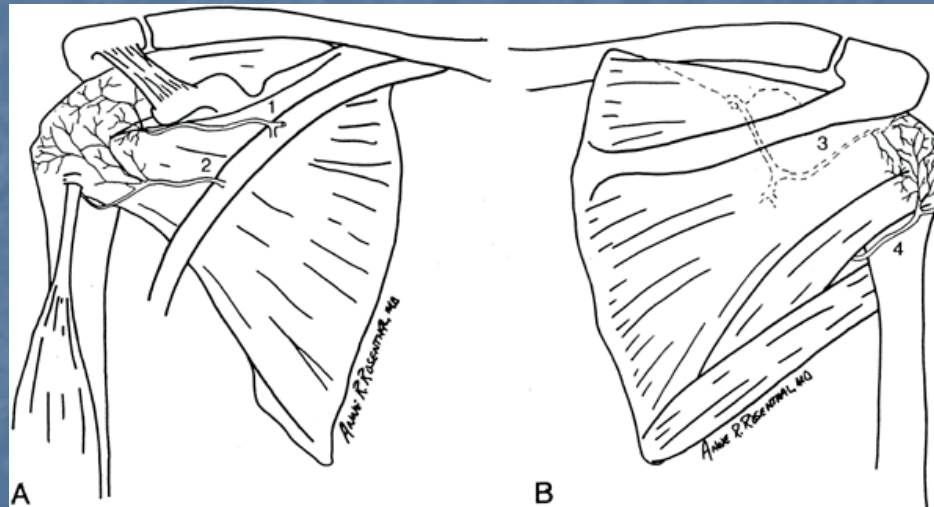
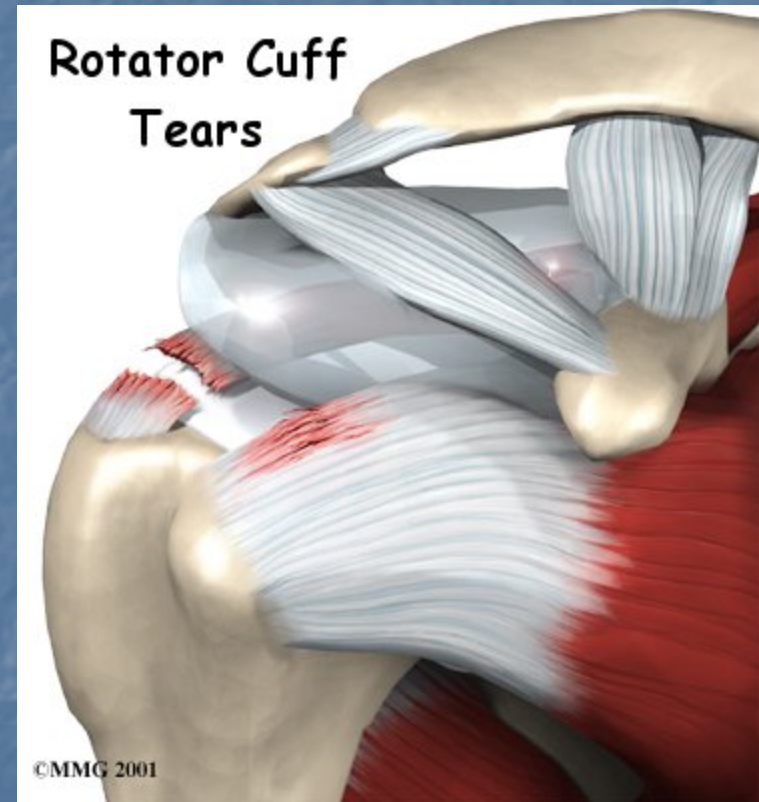


FIG. 12. Vascular supply to the rotator cuff. 1 = suprahumeral branch; 2 = anterior humeral circumflex artery; 3 = suprascapular artery; 4 = posterior humeral circumflex artery. (From ref. 27, with permission.)



# Degeneration

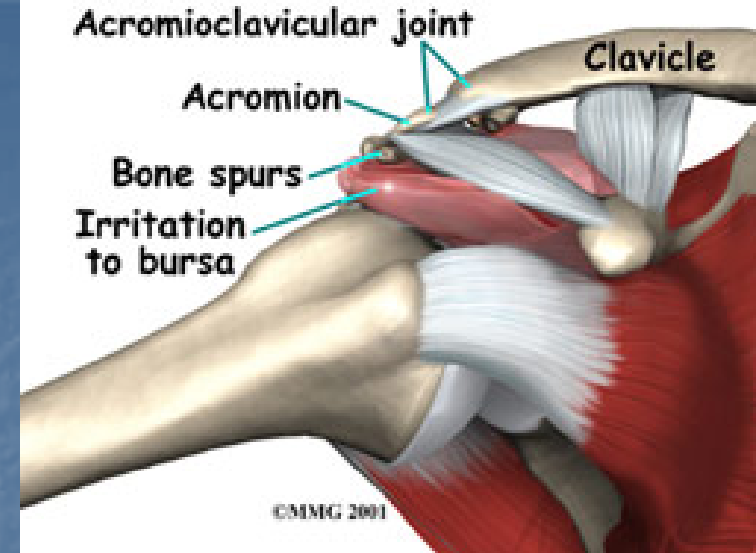
- Codman found defects 1 cm medial to insertion of cuff
- Frequency of this finding increased with age
- Concluded that degeneration in association with trauma responsible for cuff tears Codman, *Ann Surg*, 1931





# Impingement

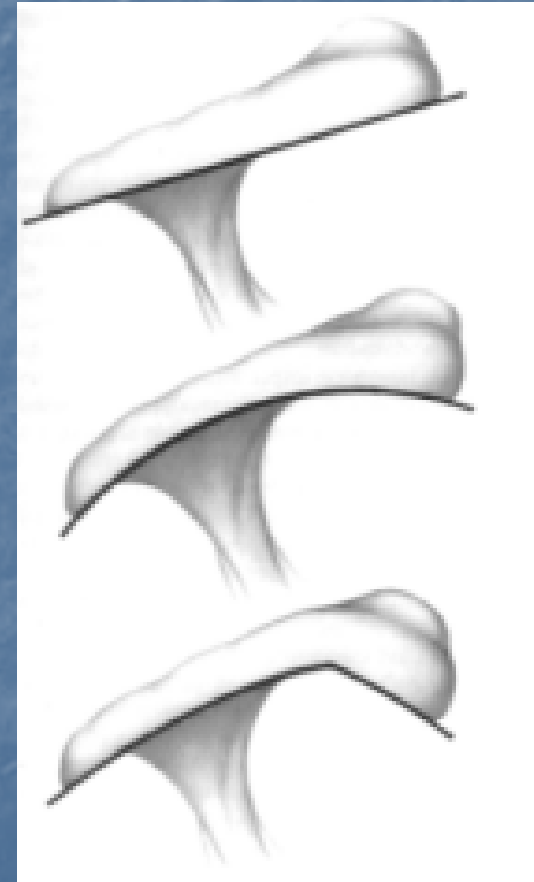
- Impingement syndrome popularized by Neer (*JBJS*, 1972)
- Repeated mechanical insult by coracoacromial arch with arm elevation
- 3 stages:
  - I. Subacromial edema, hemorrhage (age < 25)
  - II. Fibrosis, tendonitis (age 25-40)
  - III. Partial or complete tear (age > 40)





# Hooked acromions more likely to have associated cuff tears

- 70% of rotator cuff tears had type 3 acromion (hooked)
- Clinical follow-up study showed association between hooked acromion and presence of rotator cuff tears



# Trauma



- Greater tuberosity fracture
- Anterior dislocation in age >40 (Nevasier, *JBJS*, 1988)
  - Supraspinatus tear, occasional infraspinatus
  - Subscapularis tear with recurrent instability
- Posterior dislocation
  - Infraspinatus and teres minor tears with recurrent posterior instability



# Micro-Trauma

- Partial-thickness cuff tears seen in young repetitive overhead throwing athletes



# Presentation





# Typical Complaints

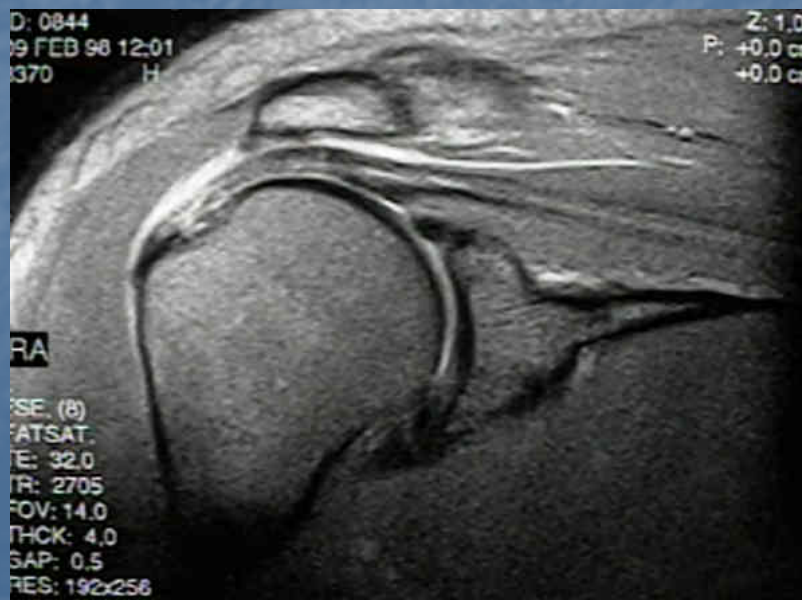
- Pain, weakness, both
- Insidious onset or specific trauma
- Pain usually anterior shoulder or down the humerus to the deltoid insertion
- Pain worse with overhead activity
- Night pain





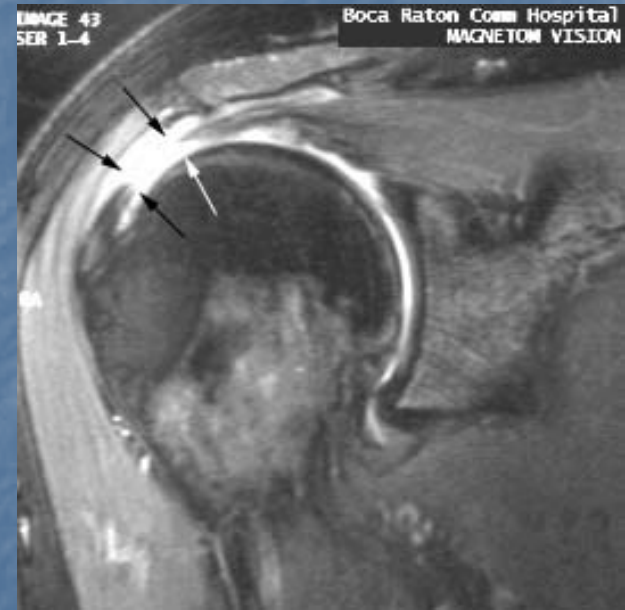
# Cuff Tears are Common

- 96 normal volunteers of all ages had MRI
- Complete tears in 14% and partial-thickness tears found in 20% of patients
- Age > 60: complete tears in 28%, partial in 26%



# Natural History

- Spontaneous healing not expected to occur – why?
  - Fibers under tension
  - Retraction common
  - Defect bridged by bursal tissue
  - Proximal stump typically avascular



# Why do some tears hurt and others don't?

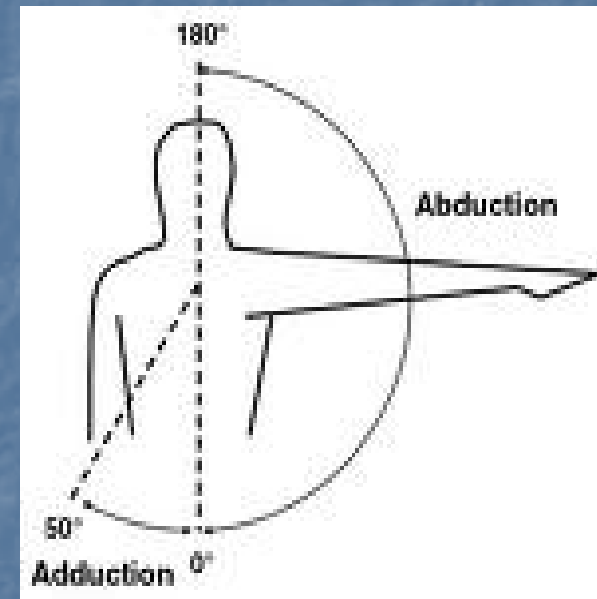
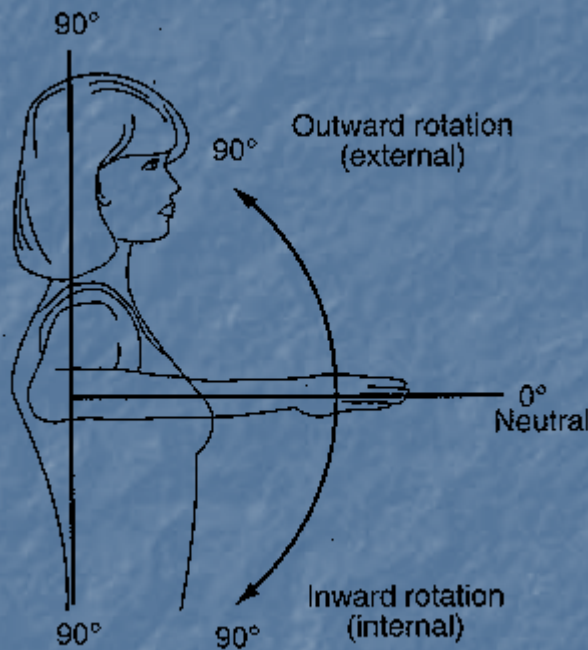
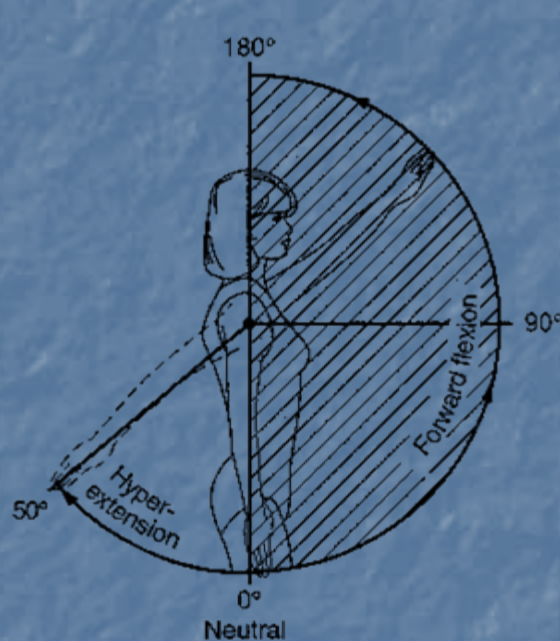
- Since tears typically don't heal there must be something else generating the pain
  - Subacromial bursa inflammation (Fukuda, *Clin Orthop*, 1994)
  - Presence of synovitis, intraarticular pathology, mechanical factors
  - Differences in pain tolerance





# Physical Exam

# Physical Exam – Range of Motion



# Strength Testing



**Supraspinatus**



**Infraspinatus**



**Subscapularis**



## Physical Exam

# Impingement Signs

### ■ Neer: "Classic"

#### Impingement I

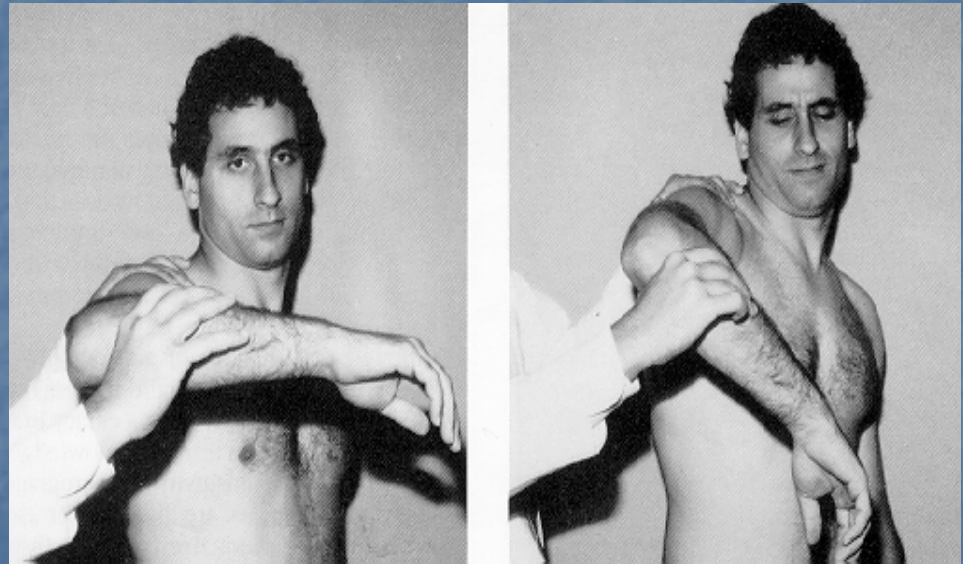
- Arm elev'd in forward plane
- Humerus int'ly rot'd during elev'n
- In presence of cuff disease, pain develops  $> 90^\circ$



### ■ Hawkins:

#### Impingement II

- Arm elev'd shoulder level
- Int'ly rot'd while adducted



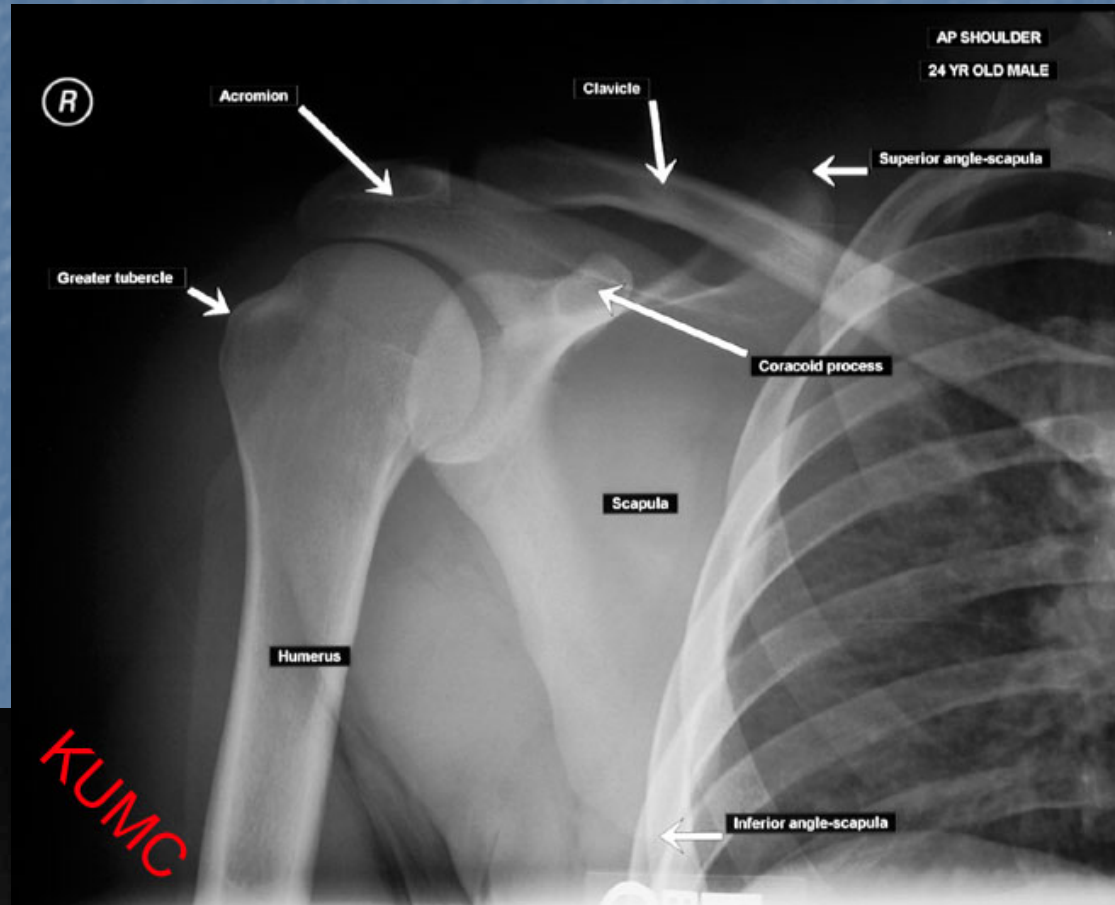
**Accentuates pain by mechanical irritation of cuff & biceps tendon beneath C-A arch**

# Radiographic Examination

# Radiographic Examination

## Trauma Series

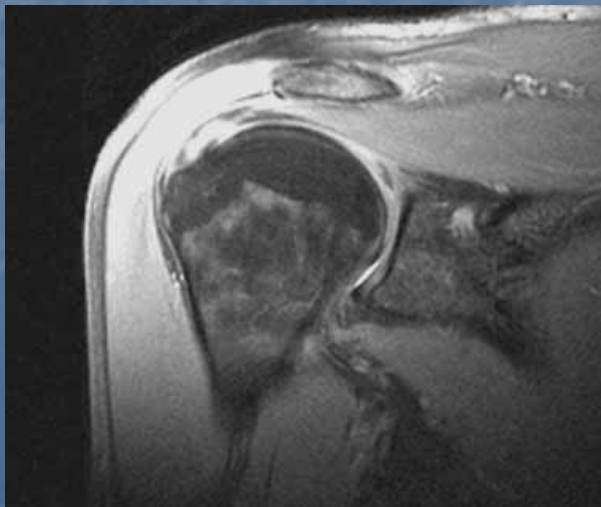
- True AP
  - 45° from thoracic plane; assess joint
- \*Axillary lateral\*
  - 70° ABD, beam





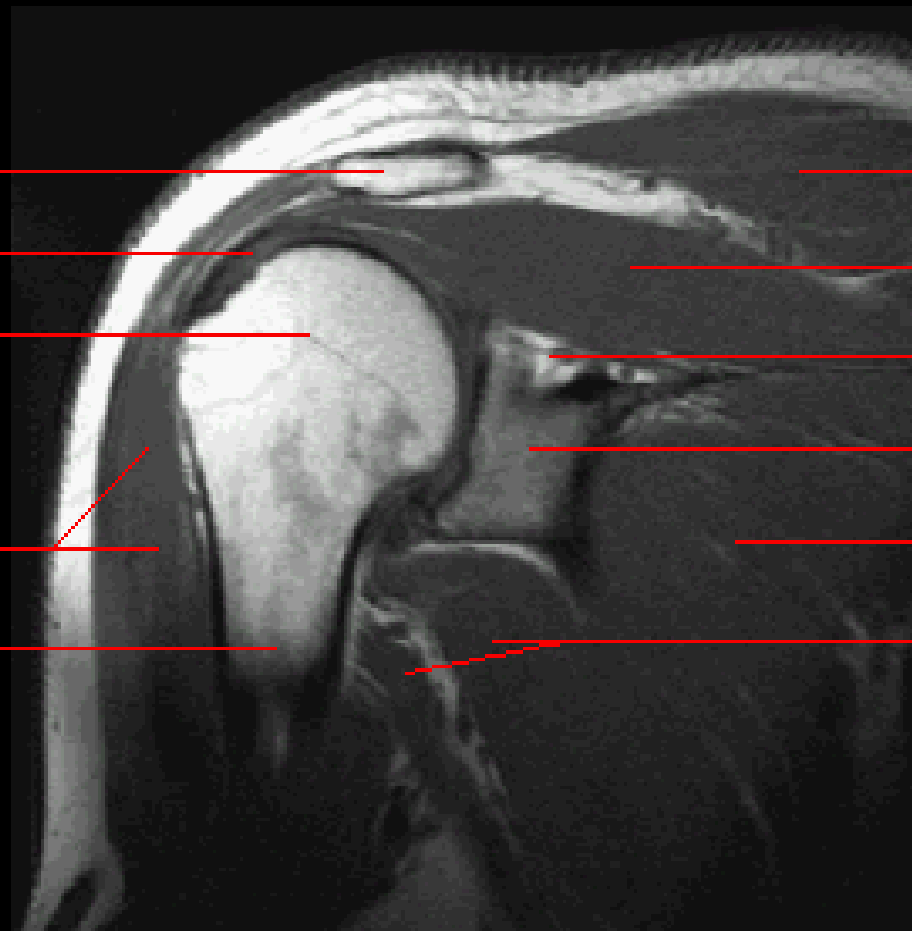
# MRI

- Imaging study of choice to determine the status of the Rotator Cuff
- Detect full vs. partial-thickness tears
- Accuracy of detecting full-thickness tears approximately 90%
- Muscle quality and fatty degeneration



# Coronal MRI Anatomy

Slice 12/18



- |                                       |                                      |
|---------------------------------------|--------------------------------------|
| Acromion                              | Trapezius m.                         |
| Rotator cuff                          | Supraspinatus m.                     |
| Humerus (head)                        | Suprascapular n. and a.              |
|                                       | Scapula, glenoid                     |
| Deltoid m. (lateral or acromial part) | Subscapularis m.                     |
| Humerus (shaft)                       | Teres major and latissimus dorsi mm. |

# Coronal Imaging of the Shoulder

- Best views to identify lesions of the supraspinatus tendon





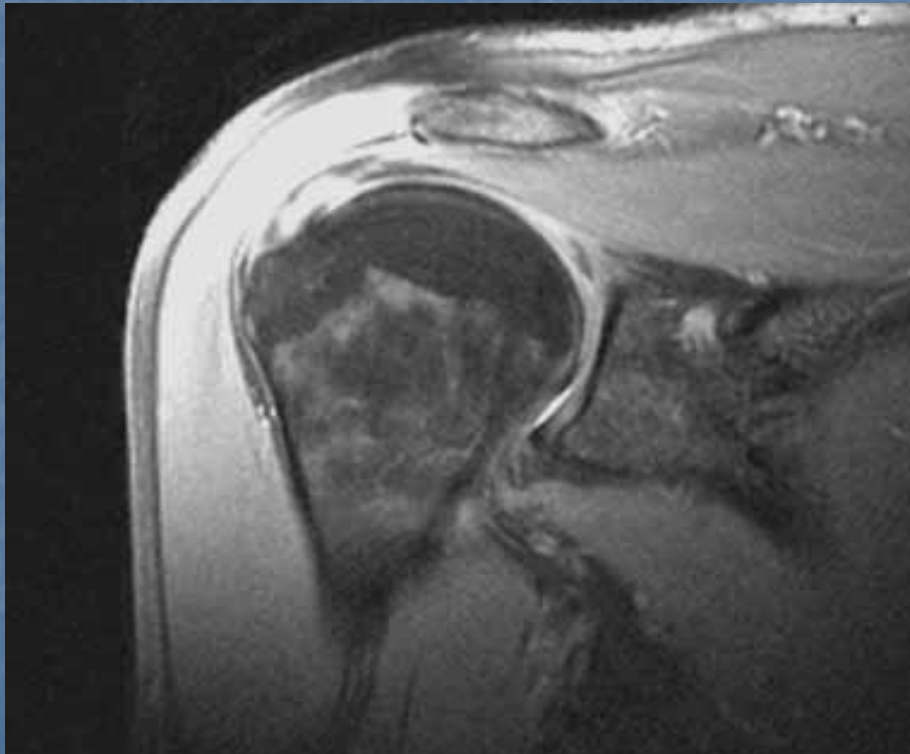
# Partial Tears



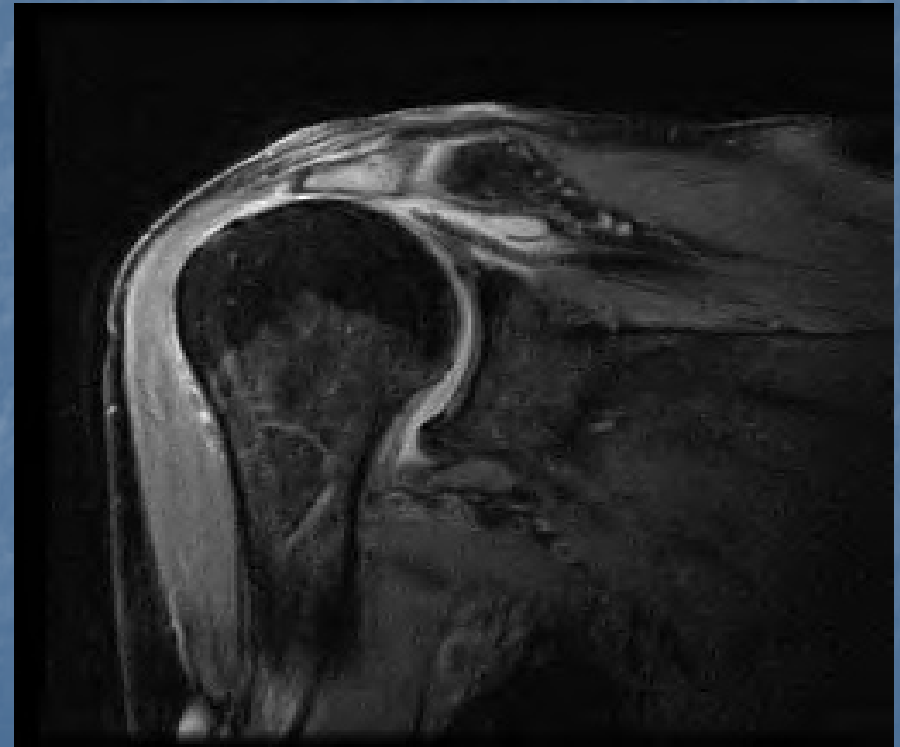
- Best seen with Arthrogram but can also be appreciated on today's higher Tesla magnets

# Complete Cuff Tears

Full Thickness Tear



Cuff Arthropathy





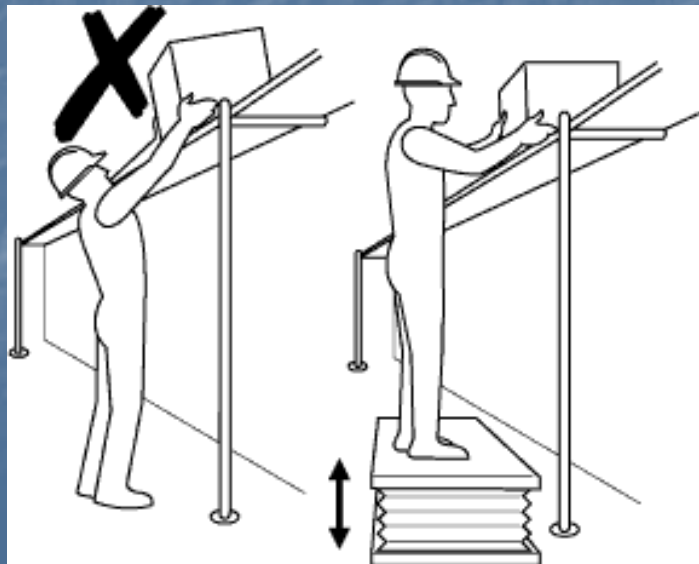
# Nonoperative Treatment Options





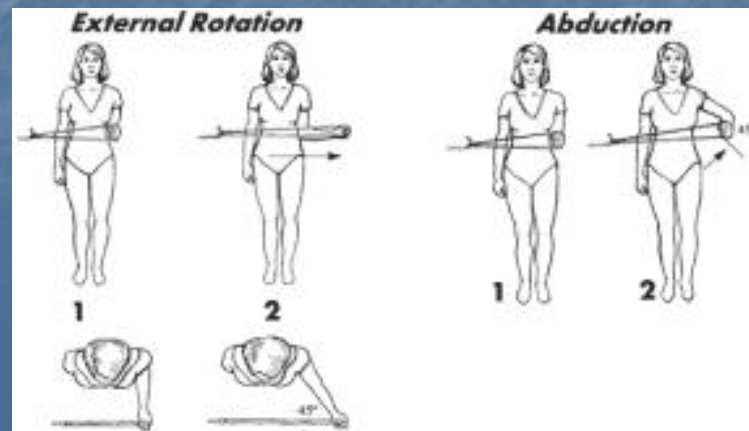
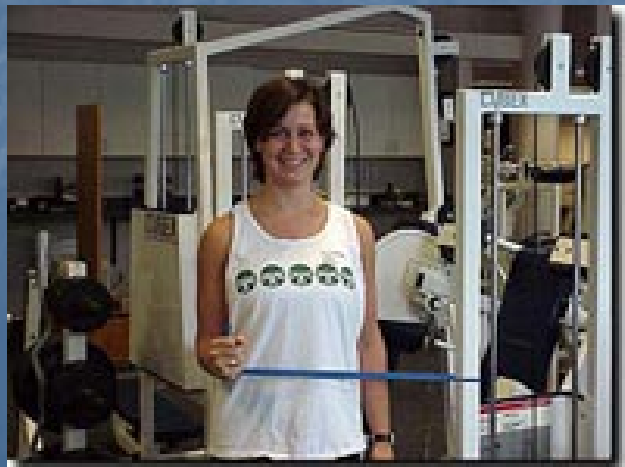
# Treatment

- Initial *non-surgical* tx for most pts w/ impingement & RCT, except young, active pts w/ acute, massive avulsions of cuff or greater tuberosity fx's
- Behavior modification to control painful motions



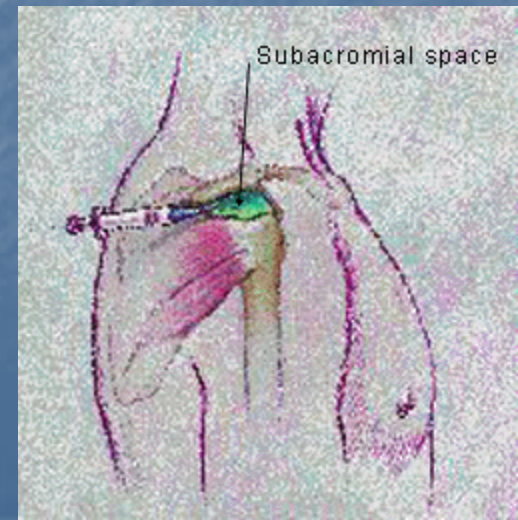
# Physical Therapy

- Step-wise progression of PT program
  - Stretch & strengthen RC musculature, deltoid & periscapulars
  - All treatment initially performed below 90° flexion in scapular plane
  - NSAIDS



# Injectons

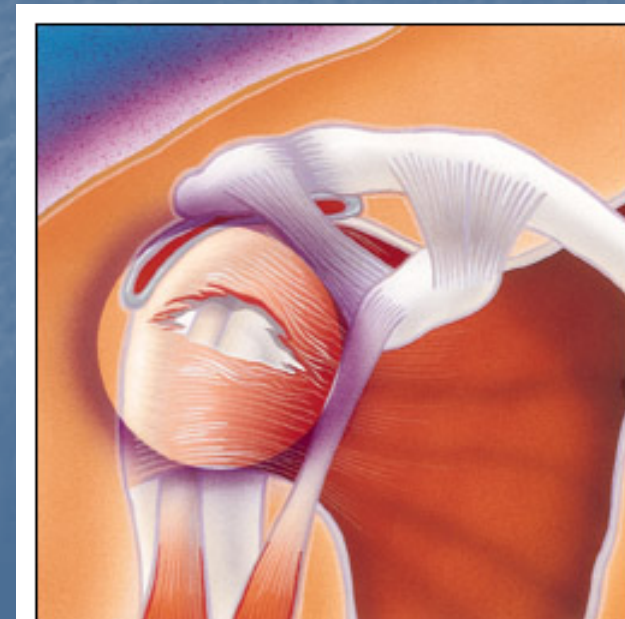
- Subacromial injections? *Controversial*
  - Dbl blind trial showed no difference compared with placebo -Withrington et al,1985
  - Adverse affects on local tissues: 17/20  $\geq 4$  injections had weak resid cuff tissue, held sutures poorly, worse results after repair -Watson





# Nonoperative Treatment

- Successful in 33% to 92% of cases
- Boker et al, *Clin Orthop*, 1993
  - 53 pts, avg. follow-up 7 years
  - 75% had satisfactory pain relief
  - Pts with long-standing pain (>6 months), did worse
- Wirth et al, *Orthop Clin North Am*, 1997
  - 60 pts, 2 year follow-up
  - 62% satisfactory result
  - 4% excellent



Full Thickness Rotator Cuff Tears

# Natural History of Nonoperatively Treated Symptomatic Rotator Cuff Tears in Patients 60 Years Old or Younger

- 51 patients followed 2-3 years with full thickness rotator cuff tears
  - Half had tears increase in size over time
  - Increase in pain correlated with increase in tear size
  - Authors concluded that most younger patients should have their rotator cuff tears fixed
- Safran et al. AJSM 2011

# Operative Interventions



Nicholas J. Avallone, M.D.  
[www.dravallone.com](http://www.dravallone.com)



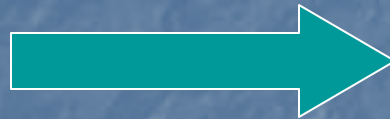


# Surgical Indications

- Presence of pain or functional deficit that interferes with ADL's that have not responded to conservative management (typically 2 to 6 months)
- This process is accelerated in those who develop weakness after an acute injury with full-thickness tear on MRI or younger individuals

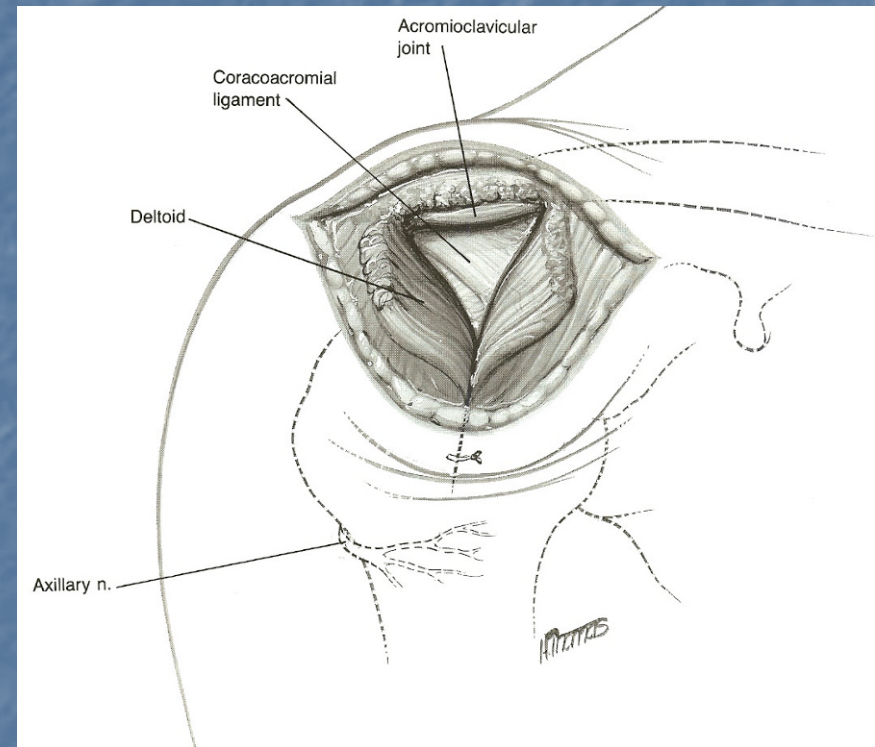
# Surgical Treatment Options

- Open
- Mini-open (arthroscopic-assisted)
- Arthroscopic



# Open

- Large incision with significant amounts of dissection.
- Significant pain postoperatively
- Rarely used now

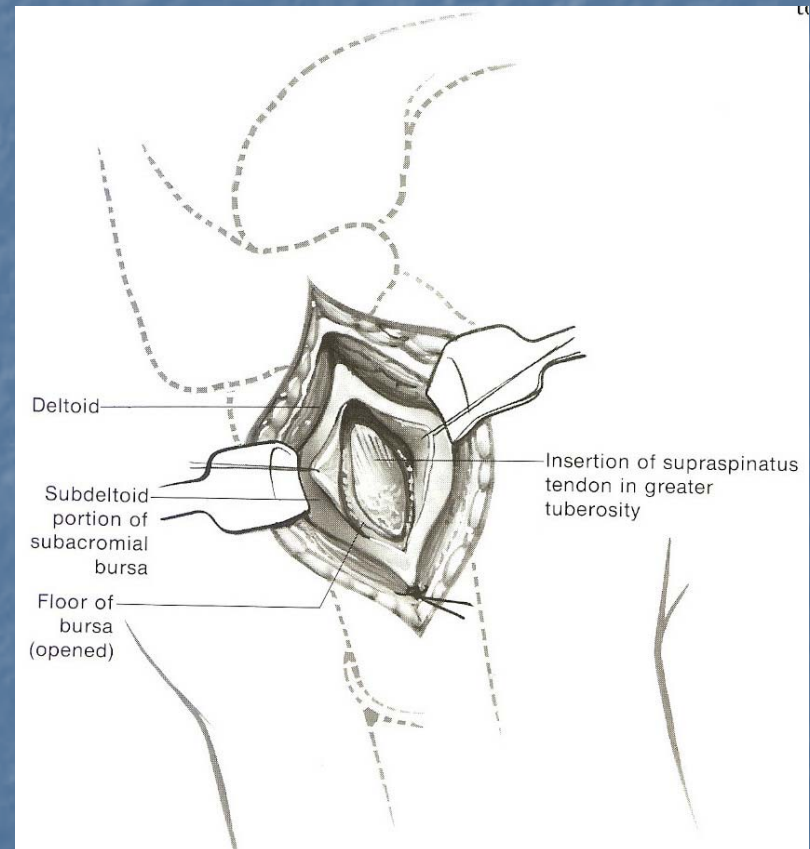


Hoppenfeld, Surgical Exposures in Orthopedics – The Anatomic Approach 2<sup>nd</sup> ed, 1994



# Mini-open

- “arthroscopic-assisted”
- Start with arthroscopy
- Arthroscopic subacromial decompression
- Smaller skin incision
- Deltoid split without detachment
- Repair performed through split



Hoppenfeld, Surgical Exposures in Orthopedics – The Anatomic Approach 2<sup>nd</sup> ed, 1994

# Transition to Arthroscopic Repair

- Survey of orthopedic surgeons
  - 1998 – 5% of AANA members surveyed did all-arthroscopic
  - 2003 – 24% of AANA members surveyed did all-arthroscopic
  - 2005 – 62% of 167 surgeons at a rotator cuff symposium at the Academy did all-arthroscopic



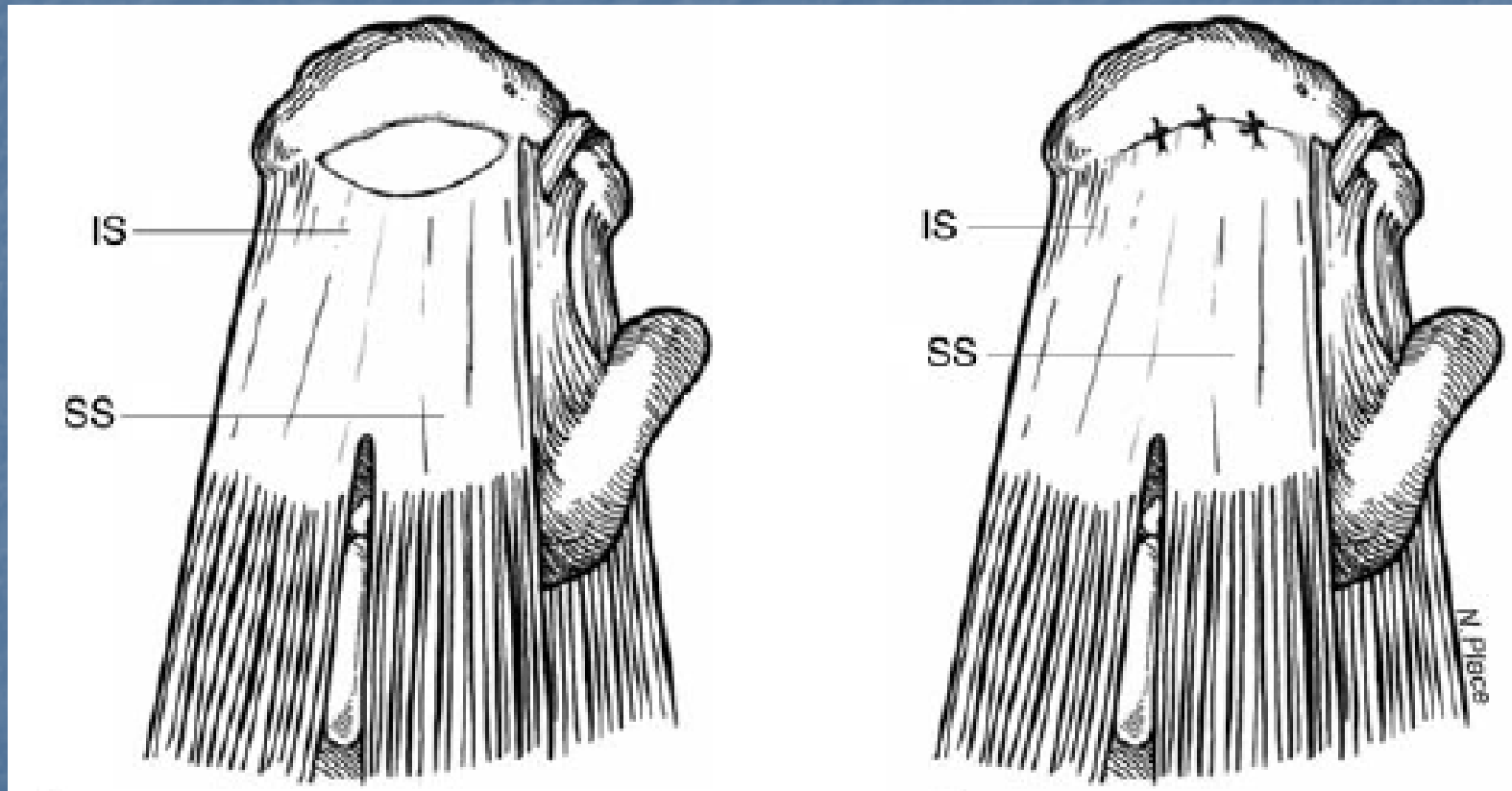


# Advantages of Arthroscopy

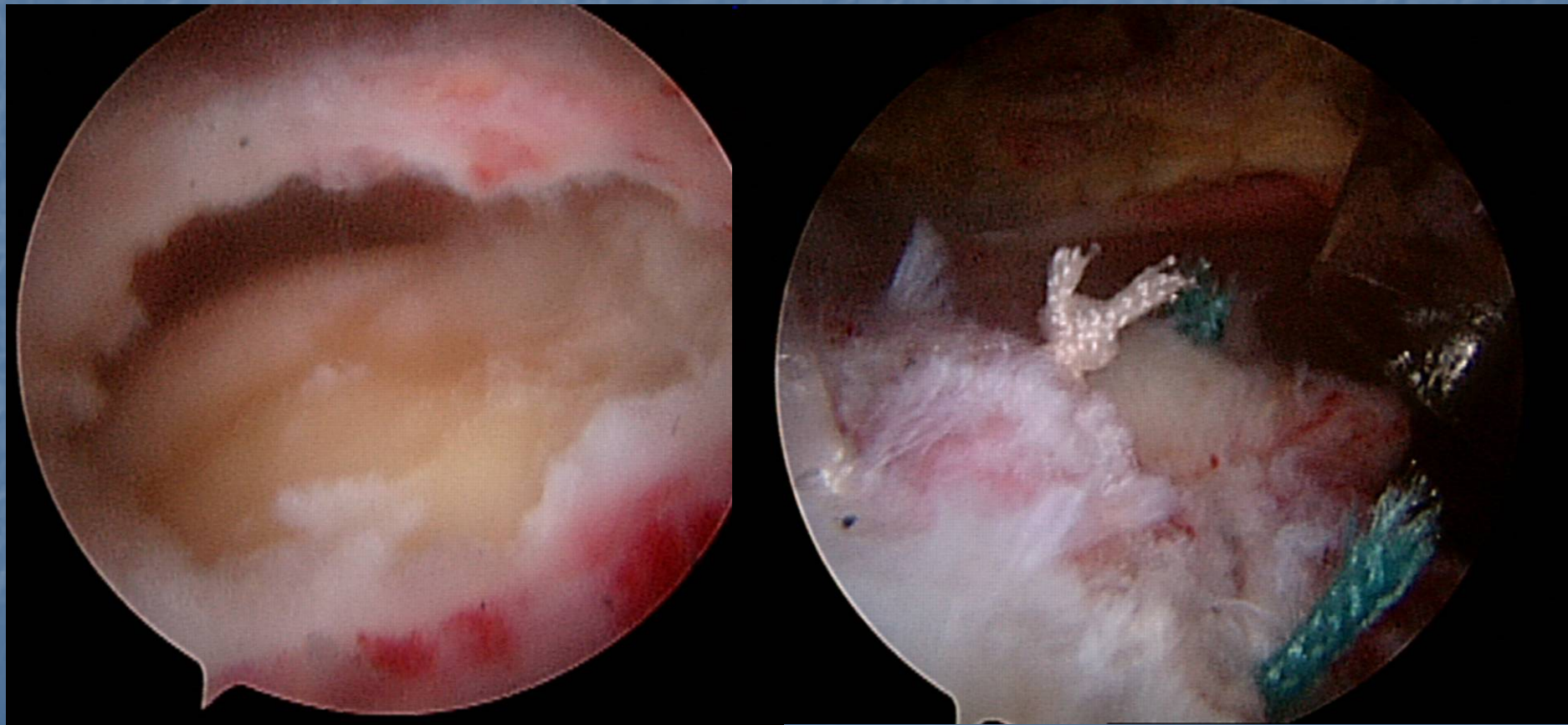
- Less dissection, trauma
- Open requires repair through anterolateral window – may not see the whole tear
- Open approach involves only medial to lateral repair mindset
- Arthroscopy allows full visualization of entire tear and tear pattern
- Allows visualization and treatment of partial-thickness cuff tears



# Typical Repair



# Arthroscopic Cuff Repair



# All-Arthroscopic Versus Mini-Open Rotator Cuff Repair: A Retrospective Review With Minimum 2-Year Follow-up

Nikhil N. Verma, M.D., Warren Dunn, M.D., M.P.H., Ronald S. Adler, Ph.D., M.D.,  
Frank A. Cordasco, M.D., Answorth Allen, M.D., John MacGillivray, M.D.,  
Edward Craig, M.D., Russell F. Warren, M.D., and David W. Altchek, M.D.

- 38 arthroscopic repairs, 33 mini-open
- No significant difference in ASES scores
- 24% recurrent defect on ultrasound with arthroscopic repair, 27% mini-open
- Persistent defect 7x more likely if original tear > 3 cm





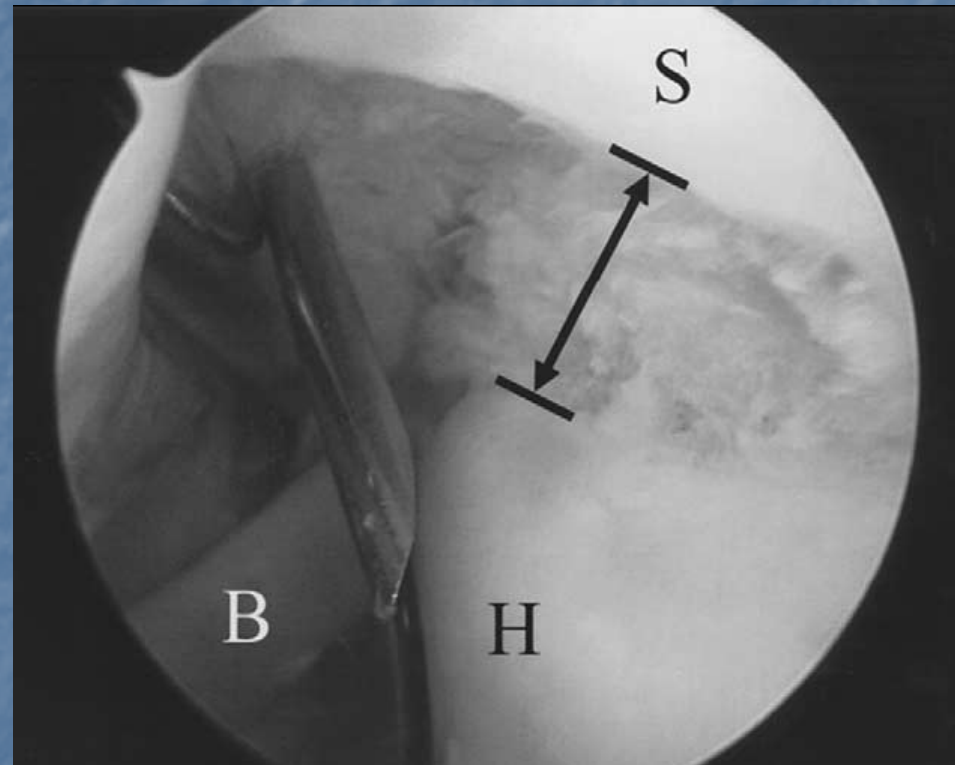
# Open Versus Arthroscopic Rotator Cuff Repair: A Comparative View of 96 Cases

Eduard Buess, M.D., Kai-Uwe Steuber, M.D., and Bernhard Waibl, M.D.

- 30 open repairs (12 open, 18 mini-open)
- 66 arthroscopic repairs
- Arthroscopic group had significantly better pain relief and higher patient satisfaction rate (92.4% vs. 80%)
- Arthroscopic group had significantly more yes answers in questions regarding mobility

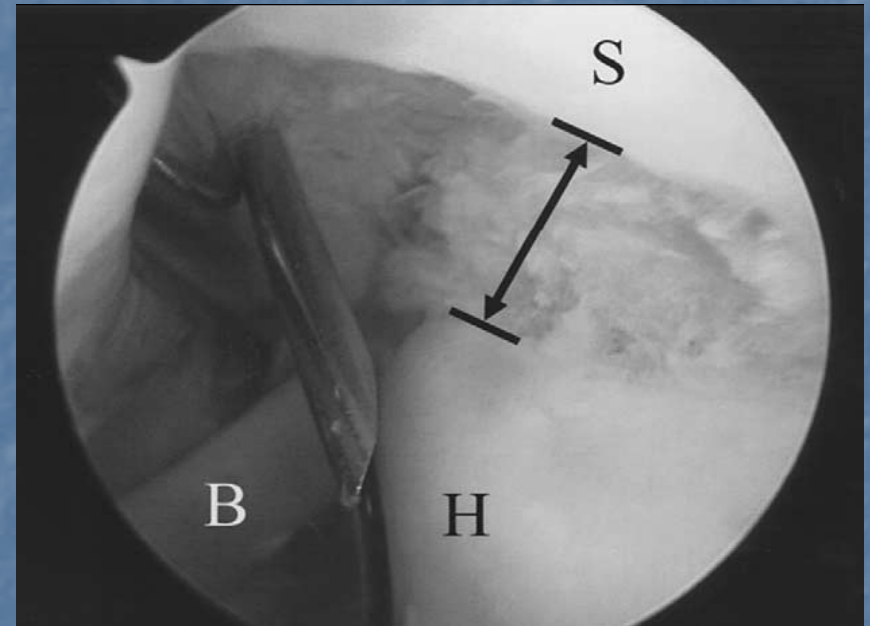
# Partial-Thickness Rotator Cuff Tears

- Mean AP dimension of supraspinatus insertion = 25 mm
- Mean medial to lateral thickness:
  - 11.6 mm at rotator interval
  - 12.1 mm at midtendon
  - 12 mm at posterior edge



# Partial-Thickness Rotator Cuff Tears

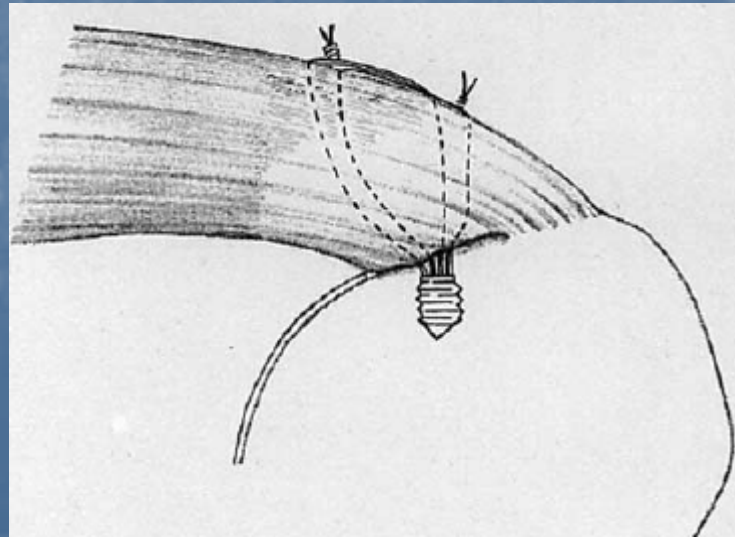
- Less than 50% of thickness:
  - ie less than 6 mm of exposed bone
  - Most recommend debridement alone
  - Suture approximation technique





# Partial-Thickness Rotator Cuff Tears

- Greater than 50% of thickness:
  - ie greater than 7 mm exposed bone
  - Repair via transtendon technique
  - or
  - Complete the tear and then repair

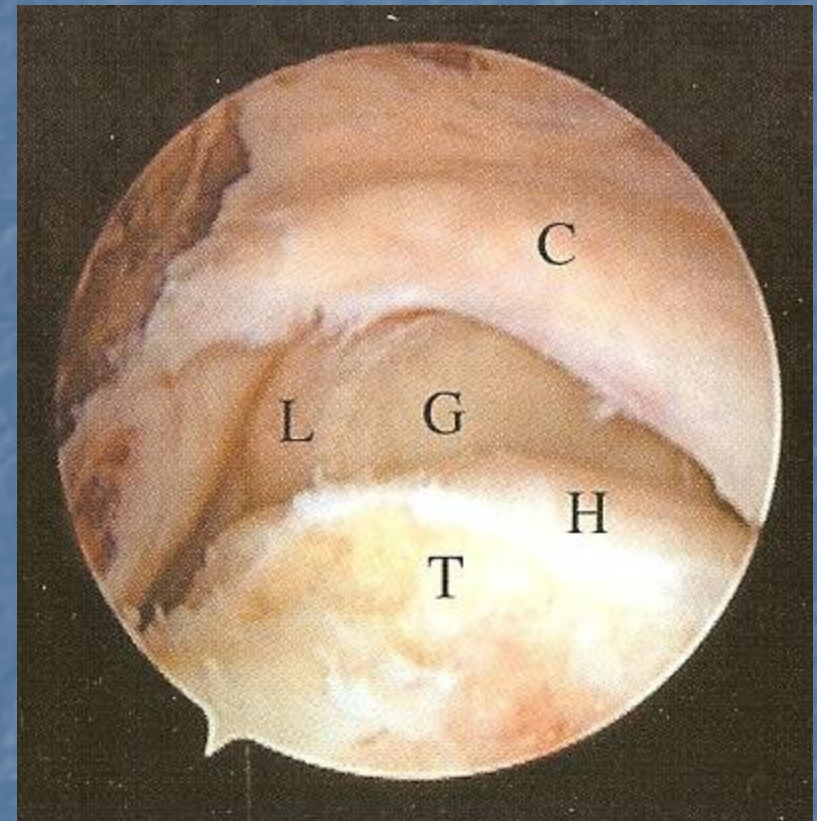


Nicholas J. Avallone, M.D.  
[www.dravallone.com](http://www.dravallone.com)



# Massive Rotator Cuff Tears

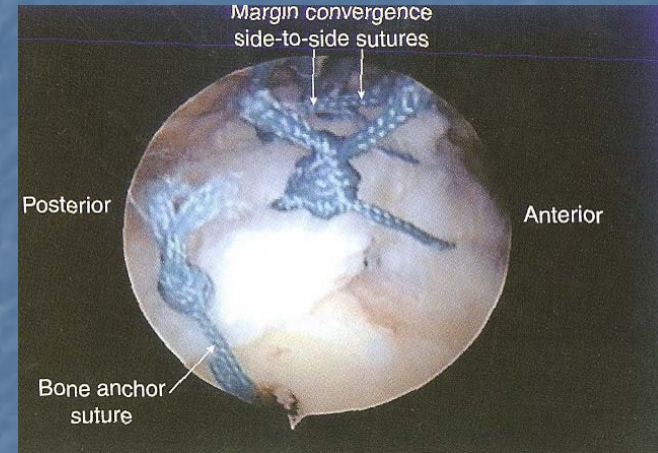
- Tears greater than 5 cm or involve detachment of 2 or more entire tendons
- May extend medial to glenoid
- Higher rate of failure of repair (some studies show 50% failure rate)





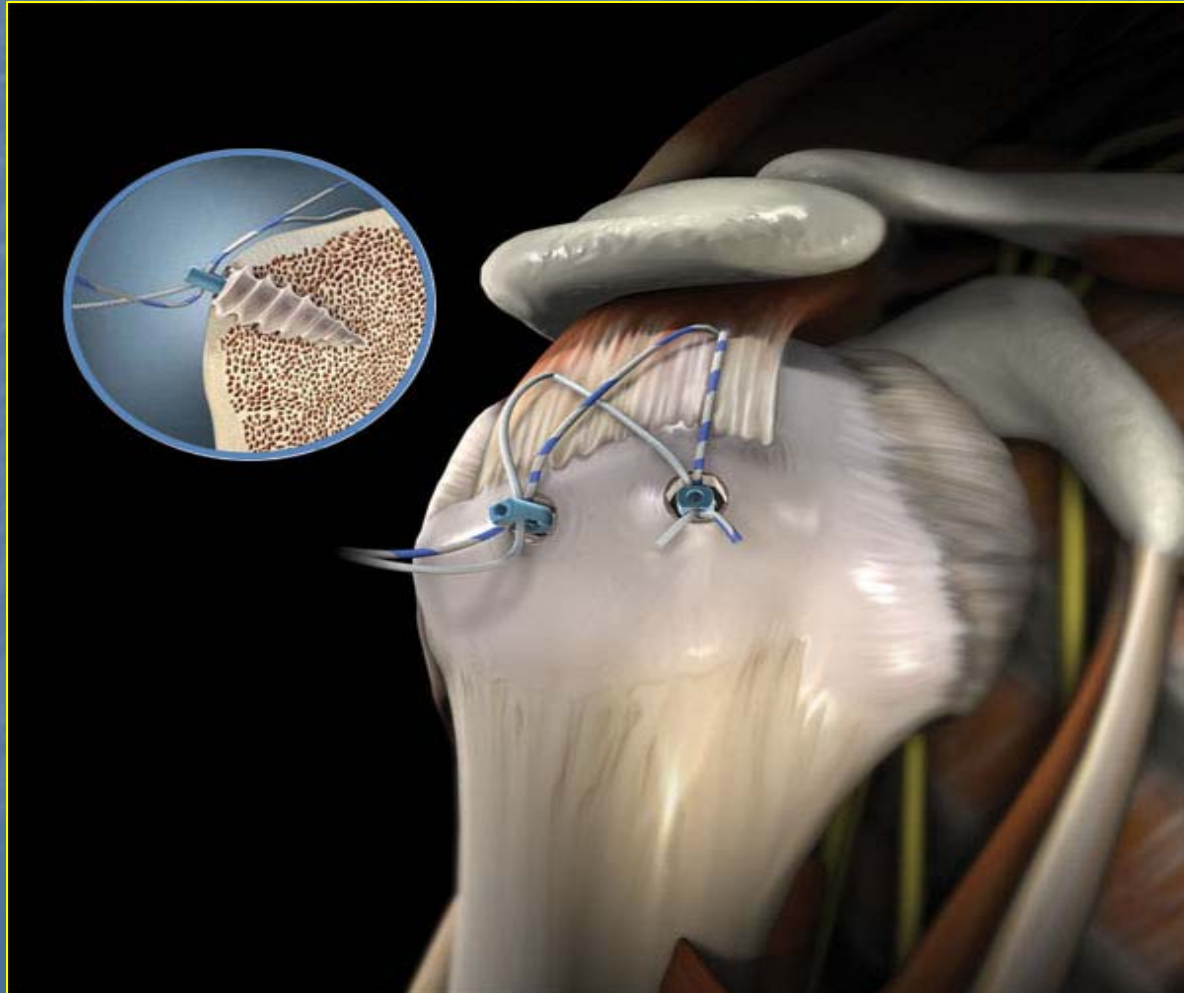
# Massive Rotator Cuff Tears

- Treatment options:
  - Limited debridement and decompression
  - Partial repair
  - Mini-open repair
  - Arthroscopic repair
  - Tendon transfers
  - Shoulder hemiarthroplasty
  - Reverse Total Shoulder Arthroplasty





# Double Row Suture Fixation with Anchors in Bone



# Comparison of the Clinical Outcomes of Single- and Double-row Repairs in Rotator Cuff Tears

- 78 patients operated on for full-thickness rotator cuff tears
  - No difference between single and double row fixation for small to medium sized tears
  - Significant difference in ASES and Constant Scores favoring double row fixation for massive cuff tears
- Park et al. AJSM 2008



# Postoperative Management

- Sling for 4 to 6 weeks
- Passive external rotation started immediately
- Passive overhead stretching started at 4-6 weeks
- Muscle strengthening started at 10-12 weeks for cuff
- Return to work usually 3-4 months postop although full strength not usually achieved until 6-12 months postop



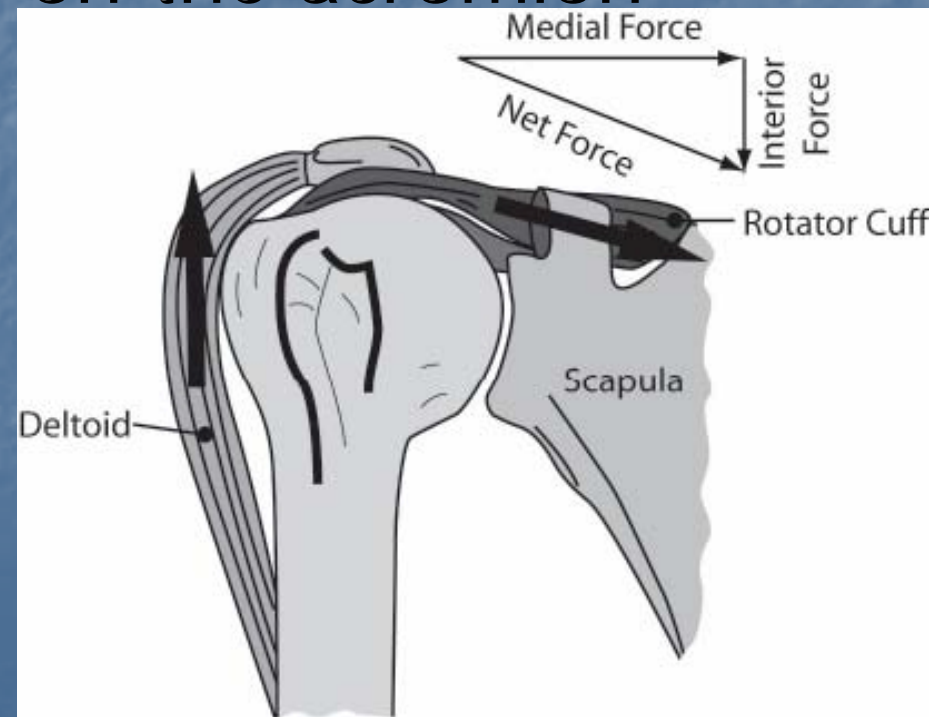
# Reverse Total Shoulder Replacement

- A good option for a rotator cuff-deficient shoulder with painful arthritis



# Problems caused by rotator cuff-deficient shoulder

- Weakness or inability to initiate abduction
- Superior migration of the humeral head causing impingement on the acromion
- Deltoid shortening causing further abduction weakness
- Unstable center of rotation



*Image Courtesy of Zimmer*



# Reverse Total Shoulder Principles

- Create congruent, stable joint surface
- Medializes center of rotation and lengthens lever arm of humerus, thus placing tension on the deltoid and allowing it to function as an abductor

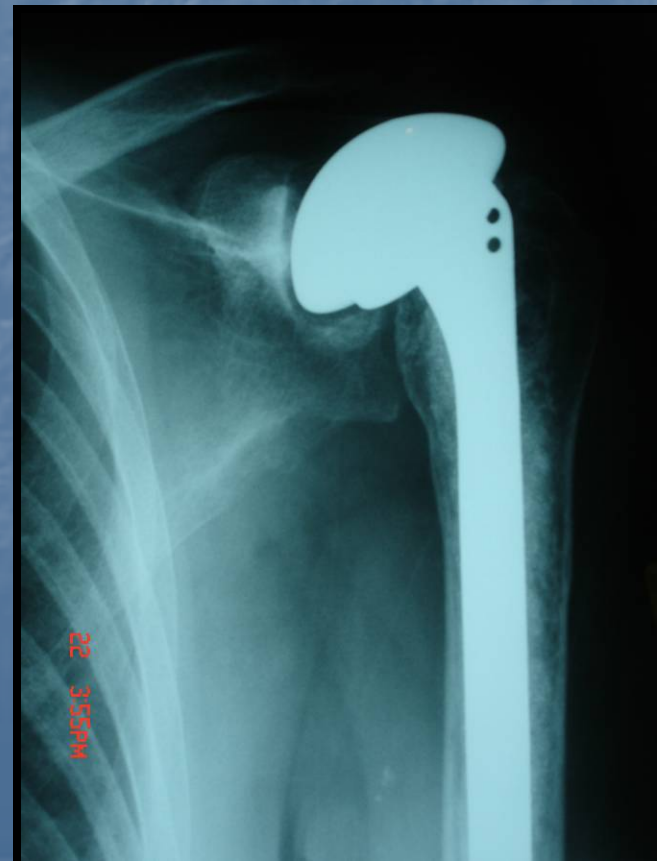
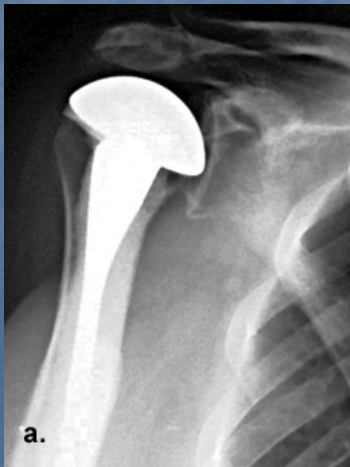


*Image Courtesy of Zimmer*



# Disease processes that may qualify

- Rotator cuff arthropathy
- Rheumatoid patients with rotator cuff tear
- Failed Hemiarthroplasty
- Acute 4-part fractures
- Malunions/Nonunions

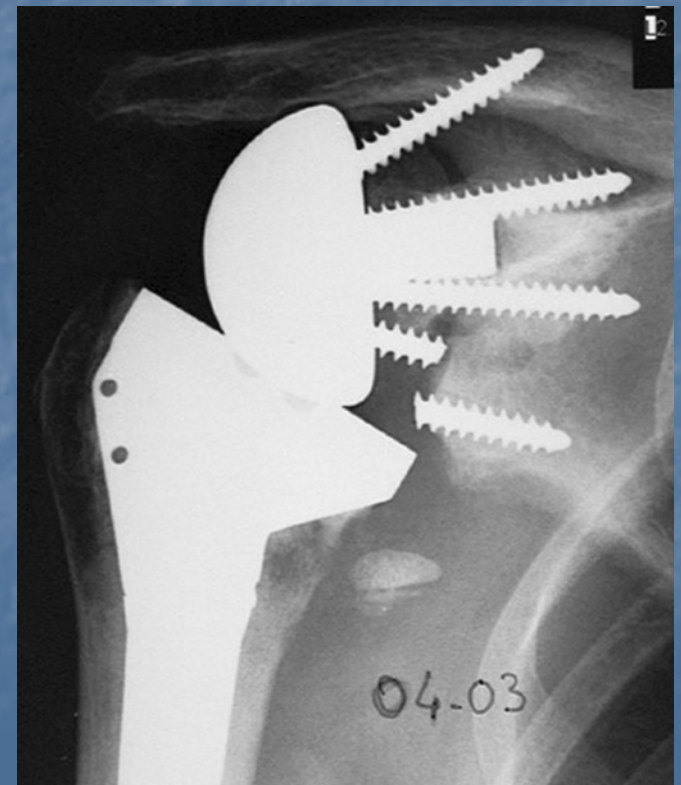




# Complications

- Overall, 19% in the largest study currently available (revision surgery 37% vs 13% for primary arthroplasty)
- Dislocation: 7.5%
- Infection: 4.5%

Walch et al. JBJS 2007



# Results

- 37 point Constant Score improvement (avg. 23 → 60 out of possible 100 points)
- 51 degrees of improvement in active elevation
- 173 out of 186 patients satisfied or very satisfied
- Best results found in primary arthroplasty for rotator cuff arthropathy







# Indications

- Narrow indications for best results
- Pseudoparalysis
- Age greater than 65 and low demand
- Good glenoid bone
- Functioning lateral deltoid
- Anterosuperior escape
- Pain

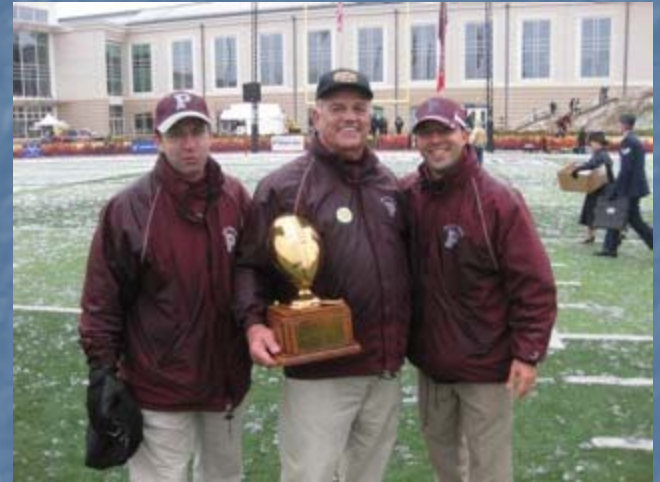


# Conclusions

- Rotator Cuff Tears are common
- Treatment initially with physical therapy except in younger patients and those with acute trauma
- Arthroscopic Management appears to have better early results with less pain, verdict still out on long-term comparison vs mini-open
- Reverse Total Shoulder now available for patients with irreparable tears



# Thank You



Nicholas J. Avallone, M.D.  
[www.dravallone.com](http://www.dravallone.com)